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Technical Memorandum

To:	Town of Amherst
From:	JM Davidson Engineering, D.P.C.
Date:	March 31, 2023
Subject:	4300 Millersport Development Project Sanitary Sewer Pump Station and Force Main Design

WM Schutt Associates (Schutt) contracted with JM Davidson Engineering, DPC (JMD), to develop a third-party engineer's report to include relevant calculations and findings to determine if the proposed sanitary wastewater pumping station proposed for the 4300 Millersport Development will function as intended (based on hydraulic calculations) and not create operational burdens or negative impacts on the existing Dockside Pump Station and force main. The third-party report was requested by the Town Engineering Office's correspondence with their Planning Department, dated February 10, 2023. This technical memorandum provides the requested information.

Background

Cimato Enterprises, LLC, proposed a new development consisting of townhomes and patio homes at 4300 Millersport Highway in the Town of Amherst. Cimato subsequently contracted with Schutt to design sanitary sewers and water lines to service the new development.

The site (4300 Millersport Highway) is located on Millersport Highway in Amherst, between New Road and Smith Road. As designed, gravity sewers would collect sanitary sewage from the development and convey flow to a new pumping station located on the development property (4300 Millersport Pump Station). This pump station would consist of two submersible pumps that would convey flows from the wet well through a 4-inch force main into the existing Dockside Pump Station force main, which runs south along the east side of Millersport Highway.

In this portion of East Amherst, existing sanitary sewer service is provided to the northeast of the 4300 Millersport site. Flows from the sewered area are tributary to the Dockside Pump Station, which is located approximately 3,700 feet north of where the 4300 Millersport force main is proposed to tie into the Dockside force main (refer to Figure 1). The Dockside force main is 10-inches in diameter and runs approximately 8,835 linear feet south along the east right-of-way on Millersport Highway, where it discharges to a gravity sewer manhole located on the Southeast corner of Millersport Highway and Hopkins Road intersection.

Report Objectives

Objectives of this memo include:

- Determining the effect of the proposed 4300 Millersport Pump Station on the Dockside Pump Station pumping capacity.
- Determining the pressure within the Dockside force main that the 4300 Millersport Pump Station will have to overcome, which affects the sizing and operating point of the 4300 Millersport pumps.
- Verifying the size of the 4300 Millersport pumps.

- Confirming that operating velocities within the force mains are still maintained within 2 and 10 feet per second in accordance with the "Recommended Standards for Wastewater Facilities, 2014", commonly known as Ten States' Standards.

Information Reviewed

Schutt provided JMD with the following information to complete the evaluation:

- Pump curves for both the existing Dockside Pump Station and the proposed 4300 Millersport Pump Station.
- Pumping data for the Dockside Pump Station, including total gallons pumped for six days in 2022 (Feb. 17, Mar. 7, Apr. 26, Jun. 9, Jun. 25, Jul. 4, and Aug. 3)
- Town of Amherst's Engineering Department's responses to Town Planning Department submittal of the proposed development, dated February 10, 2023.
- Proposed Project Design Basis, indicating basis of design for flows tributary to the proposed 4300 Millersport Development
- Drawings SW2, SW5, and SS4, dated February 2, 2023, from the 4300 Millersport Development drawings, prepared by Schutt.
- Record Drawings, submitted May 2, 2004, and prepared by Pratt & Huth Associates, LLP, for the Dockside Village Pump Station and Force Main.

Dockside Pump Station

The existing Dockside Pump Station consists of an 8,835 linear-foot, 10-inch diameter polyvinyl chloride (PVC) force main that runs south along the eastern right-of-way of Millersport Highway to a discharge manhole at the corner of Millersport Highway and Hopkins Road. The Town has indicated that no surcharging occurs at this manhole; therefore, the force main is assumed to have a free discharge into the manhole.

Two Model T61-B-4, 1350 rpm, 30 hp Gorman Rupp Pumps are provided with draw suction from a 10-ft diameter wet well. The pumps are designed to alternate operation, with one in operation at a time and the other serving as a standby. Flow data provided by the Town for select days in 2022 indicated that the pump station conveyed a range of 91,425 gpd to 349,100 gpd for the dates monitored, which corresponded to operating approximately 8% to 29% of the day, using a peak flow rate of 833 gpm, noted by Town staff as the peak flow.

JMD developed calculations for the Dockside Pump Station and force main (Attachment 1), under current conditions (i.e., operating alone) to confirm pump sizing. The calculations indicated a pump operating point of 850 gpm at 64 ft TDH, which is within 2% of the noted 833 gpm maximum flow, suggesting that the assumptions used in calculating headlosses through the force main are representative of actual conditions. Velocities within the force main at this flow range were also adequate, falling in the 2 to 10 fps range indicated in Ten States' Standards as being acceptable.

It was also noted that the original design drawing for the Dockside Pump Station showed that the original design capacity of the Dockside pumps was 750 gpm, so the actual pumps currently have more capacity than originally designed.

4300 Millersport Pump Station

Based on information provided by Schutt, the proposed development would be implemented in 3 phases with average daily flows as follows:

- Phase 1 - 17,160 gallons per day (gpd)
- Phase 2 – 6,360 gpd
- Phase 3 – 6,360 gpd
- Total – 29,880 gpd
- Future phase – 7,000 gpm
- Total Average Daily Flow for all phases – 36,880 gpd (or 25.6 gpm if spread over 24 hours)

A peaking factor of 4.04 was applied to the average daily flow, based on a served population of 369, in accordance with Ten States' Standards, yielding a projected ultimate peak flow of 148,995 gpd (or 103.4 gpm if spread over 24 hours).

The pumps proposed for this Station are Myers 4RH 20 hp, 3-phase submersible pumps with a preliminary design point of 200 gpm at 75 ft TDH.

Therefore, a flow of 200 gpm was added onto the flows from the Dockside Pump Station at the connection point with the 4300 Millersport force main to account for additional headlosses associated with the additional flow for approximately 5,140 feet of force main length. This additional headloss led to a new design point of 775 gpm at 65-ft TDH (Attachment 2), which is still greater than the original design point of 750 gpm for the Dockside Pumps.

A backpressure of 53 psi of pressure on the 4300 Millersport force main by the Dockside Pump Station at the connection point was calculated. This backpressure was then applied to the 4300 Millersport calculations to yield a revised operating point of 175 gpm at 80-ft TDH for the 4300 Millersport pumps (Attachment 3). This revised design point is capable of being achieved using the Myers pumps initially proposed by Schutt.

Conclusions

The following was concluded from this evaluation:

- Current Dockside pumping capacity of 833 gpm was confirmed with the calculations showing a design point of 850 gpm at 64-ft TDH.
- Dockside flow combined with up to 200 gpm flow from the 4300 Millersport Pump Station dropped the Dockside Pump Station flow to 775 gpm at 68-ft TDH. While less than the 833 gpm maximum observed by the Town of Amherst, note that the capacity is still greater than the 750 gpm pumping capacity that the station was originally designed for. This will result in the Dockside Pump Station running up to 10% more time per day than it is currently.
- The 4300 Millersport Pump Station was originally envisioned with a design point of 200 gpm at 75-ft TDH. When facing the backpressure associated with the Dockside Pump Station, the capacity decreases to 175 gpm, with a total discharge head of 80-ft. This point falls on the proposed pump curve, so the pumps chosen by Schutt will work for this application.

While design points for both pump stations have shifted slightly, it is expected that no adverse effects will be created with the installation of the 4300 Millersport Pump Station, as currently proposed and described in this memo, and using the horizontal and vertical alignments and pipe materials as indicated in the drawings.

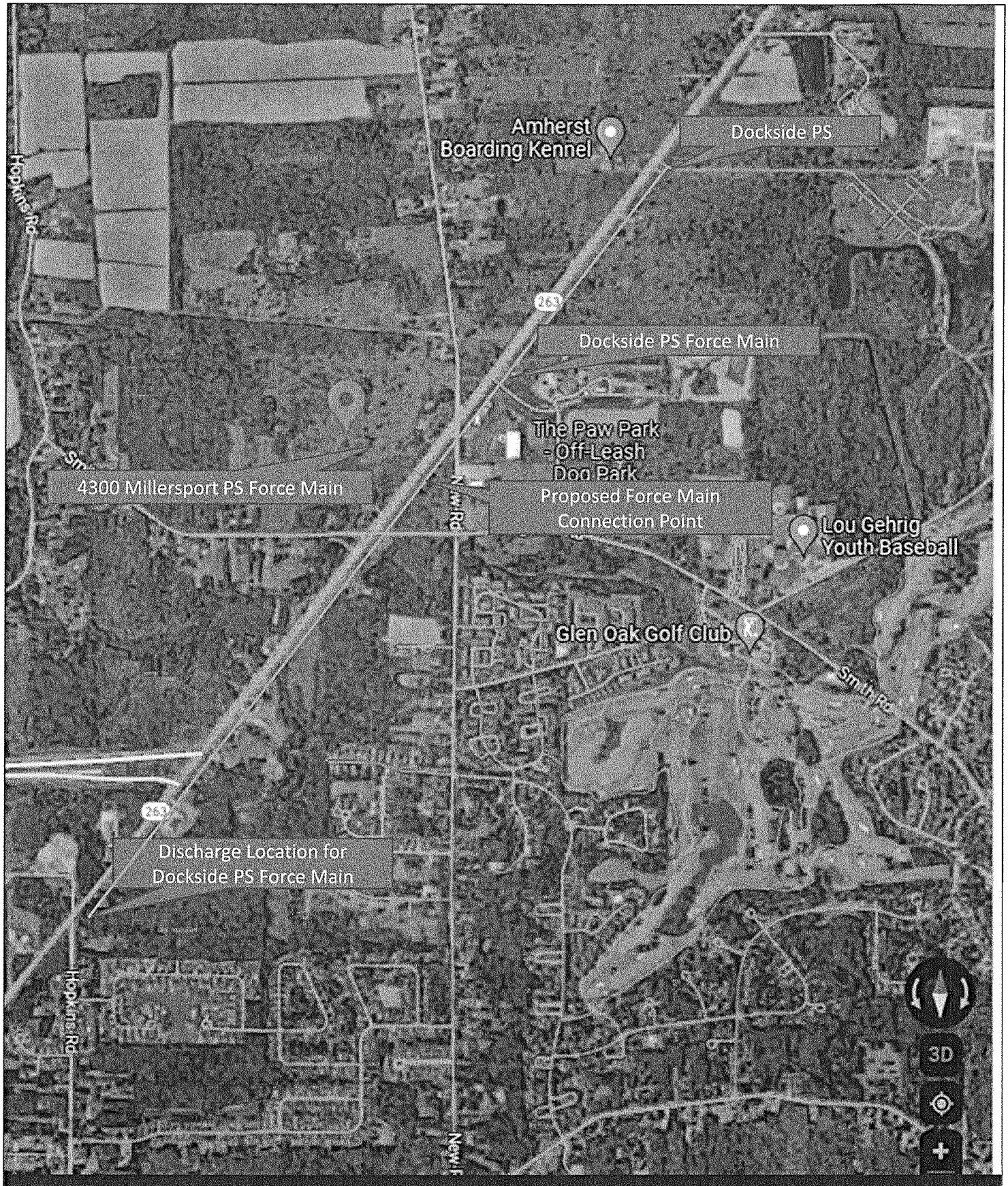

FIGURE 1

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PROJECT LOCATION MAP

Attachment 1

Dockside Pump Station Calculations and Curves

SYSTEM HEAD CURVE DETERMINATION

JMDavidson Engineering, D.P.C.

TOWN OF AMHERST/ WM. SCHUTT ASSOCIATES
4300 MILLERSPORT HIGHWAY
JMD Project No. 342301 - calculations for Dockside PS to confirm pump capacity.

The following formulas and assumptions were used in the calculations contained in this spreadsheet:

1. Pump operation scenarios: From Dockside Pump Station to Discharge Point at manhole at corner of Hopkins and Millersport.

2. Information on pumps, force main alignment and proposed flows provided by Wm Schutt on 3/9/2023. One pump operates at a time, with the second pump operating as a standby.

3. Piping head loss calculations use Hazen-Williams Formula for Water
   h=[(4.73*Q^1.85)*L]/(C^1.85*D^4.87) where: h = Head Loss
   Q = Flow (cfs)
   C = Roughness Coefficient
   D = Pipe Diameter (ft.)
   L = Pipe Length (ft.)

4. Fitting, entrance, and exit head loss calculations for water:
   h=KV^2/2g where: h = Head Loss
   K = Resistance Coefficient
   V = Flow Velocity (Q/A)
   g = Gravity (32.2 ft/sec^2)

K-values were obtained from "Cameron Hydraulic Data Handbook, 18th Edition" (1998) by Ingersoll-Dresser Pumps
For reducers, velocity of smaller end is used and for increasers the difference between the small and large end square velocities is used .
For tees with different inlet and outlet diameters, velocity in smaller diameter pipe is used.

A. HEAD LOSS OF SUCTION WELL TO PUMP (WET PIT SUBMERSIBLE)

Pipe assumed to be unlined ductile iron pipe per Pump Station Note No. 6

Fitting	No.	Inlet Dia.	Outlet Dia,	Length ft	C	K	(GPM) 0	100	200	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400
Entrance Loss	1	-	10	-	-	0.50	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.09	0.10	0.13	0.16	0.19	0.22	0.25
Reducer	1	10	6	2	-	0.084	0.00	0.00	0.01	0.02	0.03	0.04	0.06	0.08	0.11	0.14	0.17	0.20	0.24	0.28	0.33
Piping Friction	-	-	6	6	100	-	0.00	0.01	0.04	0.08	0.13	0.20	0.28	0.38	0.48	0.60	0.73	0.87	1.02	1.18	1.36
45 deg bend	1	-	6	-	-	0.24	0.00	0.00	0.02	0.04	0.06	0.12	0.17	0.24	0.31	0.39	0.48	0.58	0.69	0.81	0.94
Piping Friction	-	-	6	6	100	-	0.00	0.01	0.04	0.08	0.13	0.20	0.28	0.38	0.48	0.60	0.73	0.87	1.02	1.18	1.36
Wye, thru	1	-	6	-	-	0.30	0.00	0.01	0.02	0.05	0.10	0.15	0.22	0.29	0.38	0.49	0.60	0.73	0.86	1.01	1.18
Piping Friction	-	-	6	6	100	-	0.00	0.01	0.04	0.08	0.13	0.20	0.28	0.38	0.48	0.60	0.73	0.87	1.02	1.18	1.36
45 deg bend	1	-	6	-	-	0.24	0.00	0.00	0.02	0.04	0.06	0.12	0.17	0.24	0.31	0.39	0.48	0.58	0.69	0.81	0.94
Piping Friction	-	-	6	6	100	-	0.00	0.01	0.04	0.08	0.13	0.20	0.28	0.38	0.48	0.60	0.73	0.87	1.02	1.18	1.36
Gate Valve	1	-	6	-	-	0.12	0.00	0.00	0.01	0.02	0.04	0.06	0.09	0.12	0.15	0.19	0.24	0.29	0.35	0.41	0.47
Pump																					
						Subtotal:	0.00	0.06	0.23	0.50	0.87	1.33	1.89	2.54	3.27	4.10	5.01	6.02	7.11	8.28	9.54

B. HEAD LOSS CALCULATION FOR 4-INCH DISCHARGE FORCE MAIN FROM PUMP TO DOCKSIDE FORCE MAIN DISCHARGE POINT (DOCKSIDE OPERATING ALONE)

Fitting	No.	Inlet Dia.*	Outlet Dia,*	Length ft	C	K	(GPM) 0	100	200	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400
Check Valve	1	-	6	-	-	1.50	0.00	0.05	0.12	0.27	0.48	0.75	1.08	1.47	1.92	2.43	3.00	3.63	4.32	5.07	5.88
90 deg bend	1	-	6	-	-	0.45	0.00	0.01	0.03	0.06	0.11	0.17	0.24	0.32	0.42	0.53	0.65	0.79	0.94	1.10	1.28
Piping Friction (FRP)	-	-	6	6	140	-	0.00	0.01	0.02	0.04	0.07	0.11	0.15	0.20	0.26	0.32	0.39	0.47	0.55	0.64	0.75
Plug Valve (3-way)	1	-	6	-	-	0.45	0.00	0.01	0.03	0.06	0.11	0.17	0.24	0.32	0.42	0.53	0.65	0.79	0.94	1.10	1.28
Piping Friction (FRP)	-	-	6	6	140	-	0.00	0.01	0.02	0.04	0.07	0.11	0.15	0.20	0.26	0.32	0.39	0.47	0.55	0.64	0.75
45 deg bend	2	-	4	-	-	0.24	0.00	0.05	0.19	0.44	0.78	1.21	1.75	2.38	3.11	3.93	4.86	5.88	7.00	8.21	9.52
Piping Friction (FRP)	-	-	6	6	140	-	0.00	0.01	0.02	0.04	0.07	0.11	0.15	0.20	0.26	0.32	0.39	0.47	0.55	0.64	0.75
Increaser	1	6	10	2	-	0.175	0.00	0.00	0.01	0.03	0.05	0.08	0.11	0.15	0.19	0.25	0.30	0.37	0.44	0.51	0.60
Piping Friction (PVC) to connection	-	-	10	3696	140	-	0.00	0.28	1.02	2.16	3.68	5.55	7.78	10.35	13.25	16.48	20.02	23.89	28.06	32.54	37.32
Piping Friction (PVC) to discharge	-	-	10	5139	140	-	0.00	0.39	1.42	3.00	5.11	7.72	10.82	14.39	18.43	22.91	27.84	33.21	39.01	45.24	51.89
Pipe Exit	1	-	10	-	-	1.00	0.00	0.00	0.01	0.02	0.04	0.06	0.09	0.13	0.17	0.21	0.26	0.31	0.37	0.44	0.51
Subtotal (for total force main length):							**0.00**	**0.79**	**2.91**	**6.21**	**10.64**	**16.16**	**22.74**	**30.36**	**39.00**	**48.64**	**59.26**	**70.87**	**83.43**	**96.96**	**111.43**
Subtotal (to point of connection with 4300 Millersport PS force main):							**0.00**	**0.40**	**1.48**	**3.18**	**5.49**	**8.37**	**11.83**	**15.84**	**20.41**	**25.51**	**31.16**	**37.34**	**44.05**	**51.28**	**59.03**

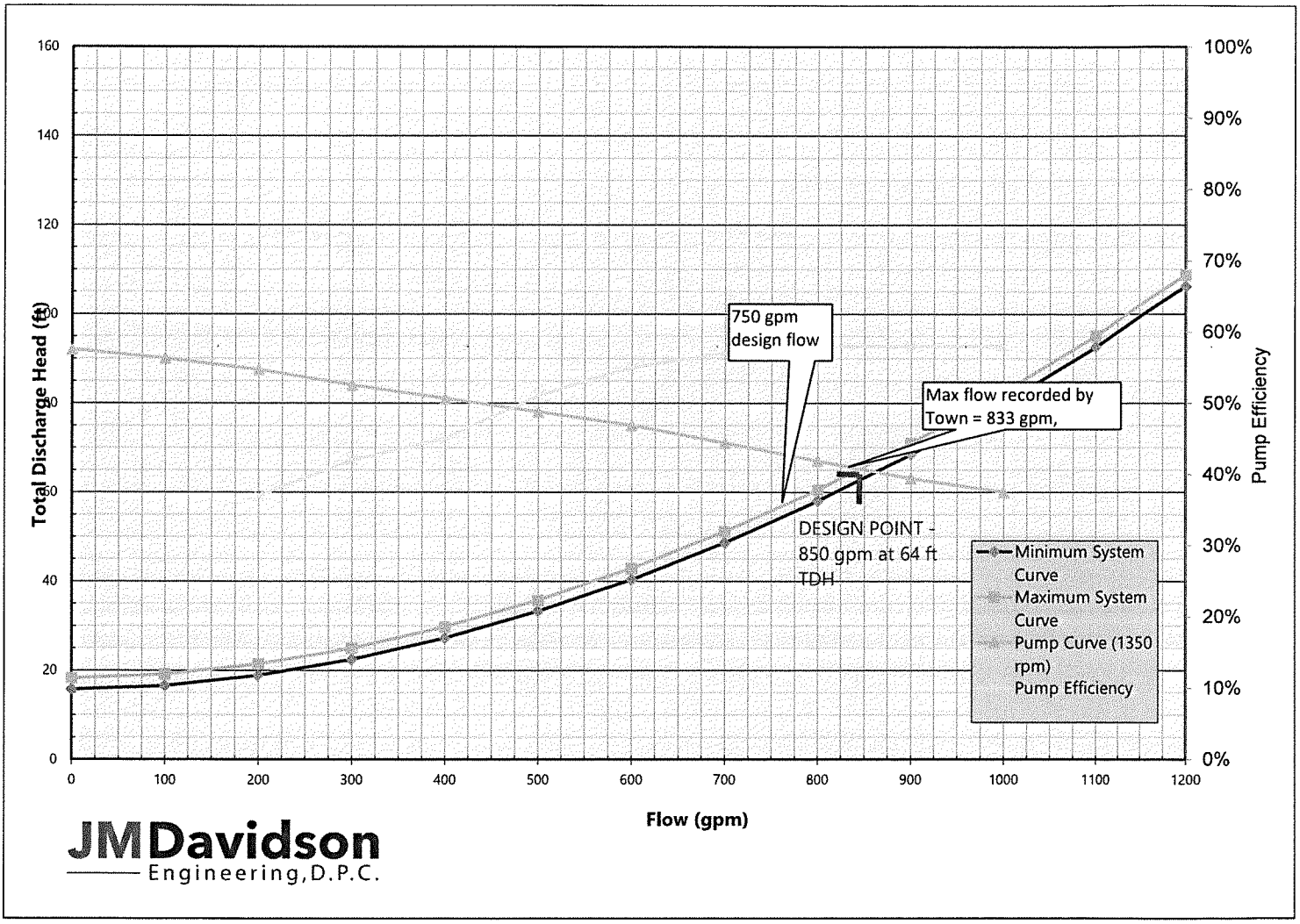
SUMMARY TABLE

FLOW (GPM)			0	100	200	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400
PUMP STATION																	
WET WELL LOW WATER LEVEL (from drawing)			556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60
WET WELL HIGH WATER LEVEL (from drawing)			559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10
FORCE MAIN																	
VELOCITY IN FORCE MAIN (fps)*	DIAMETER (inch):	6	0.00	1.14	2.27	3.41	4.55	5.68	6.82	7.95	9.09	10.23	11.36	12.50	13.64	14.77	15.91
(recommended to operate between 2 and 10 fps per 10SS)		10	0.00	0.41	0.82	1.23	1.64	2.05	2.45	2.86	3.27	3.68	4.09	4.50	4.91	5.32	5.73
HEAD LOSSES IN FORCE MAIN (sum of suction losses and discharge losses)			0.00	0.86	3.14	6.71	11.51	17.49	24.63	32.89	42.27	52.73	64.28	76.88	90.54	105.24	120.97
HEAD LOSSES IN FORCE MAIN (to point of connection)			0.00	0.46	1.71	3.69	6.36	9.70	13.71	18.37	23.68	29.61	36.17	43.36	51.15	59.56	68.58
Discharge Pressure (assumes free discharge)			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PUMP DISCHARGE PIPE EXIT ELEVATION			574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80
MIN SYSTEM CURVE			15.7	16.6	18.8	22.4	27.2	33.2	40.3	48.6	58.0	68.4	80.0	92.6	106.2	120.9	136.7
MAX SYSTEM CURVE			18.2	19.1	21.3	24.9	29.7	35.7	42.8	51.1	60.5	70.9	82.5	95.1	108.7	123.4	139.2

Calculations Completed 3/15/2023 *by* A. Hintz
Calculations Checked 3/21/2023 *by* C. Goerss-Murphy

*Red highlighted cells indicate those velocities outside of the normal operating range of 2-8 fps.
However, the operation of the Dockside PS is outside of the scope of this work, but only needed to calculate pressure on 4300 Millersport PS force main.

Max flow recorded by Town = 833 gpm
Based on Dockside Alone curve, design point should be 850 gpm.
Delta = 17 gpm
Calc within 2.0%
i.e., assumptions made during this evaluation are valid.



Dockside Alone Graph

Attachment 2

Dockside + 4300 Millersport Pump Station Calculations and Curves

SYSTEM HEAD CURVE DETERMINATION

TOWN OF AMHERST/ WM. SCHUTT ASSOCIATES
4300 MILLERSPORT HIGHWAY
JMD Project No. 342301 - calculations for Dockside PS to feed into calculations for 4300 Millersport

JMDavidson Engineering, D.P.C.

The following formulas and assumptions were used in the calculations contained in this spreadsheet:

1. Pump operation scenarios: From Dockside Pump Station to Discharge Point.

2. Information on pumps, force main alignment and proposed flows provided by Wm Schutt on 3/9/2023. Pu

3. Piping head loss calculations use Hazen-Williams Formula for Water
   h=[(4.73*Q^1.85)*L]/(C^1.85*D^4.87) where: h = Head Loss
   Q = Flow (cfs)
   C = Roughness Coefficient
   D = Pipe Diameter (ft.)
   L = Pipe Length (ft.)

4. Fitting, entrance, and exit head loss calculations for water:
   h=KV^2/2g where: h = Head Loss
   K = Resistance Coefficient
   V = Flow Velocity (Q/A)
   g = Gravity (32.2 ft/sec^2)

K-values were obtained from "Cameron Hydraulic Data Handbook, 18th Edition" (1998) by Ingersoll-Dresser Pumps
For reducers, velocity of smaller end is used and for increasers the difference between the small and large end square velocities is used .
For tees with different inlet and outlet diameters, velocity in smaller diameter pipe is used.

A. HEAD LOSS OF SUCTION WELL TO PUMP (WET PIT SUBMERSIBLE)

Pipe assumed to be unlined ductile iron pipe per Pump Station Note No. 6

Fitting	No.	Inlet Dia.	Outlet Dia,	Length ft	C	K	(GPM) 0	100	200	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400
Entrance Loss	1	-	10	-	-	0.50	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.10	0.13	0.16	0.19	0.22	0.25
Reducer	1	10	6	2	-	0.084	0.00	0.00	0.01	0.02	0.03	0.04	0.06	0.08	0.11	0.14	0.17	0.20	0.24	0.28	0.33
Piping Friction	-	-	6	5	100	-	0.00	0.01	0.04	0.08	0.13	0.20	0.28	0.38	0.48	0.60	0.73	0.87	1.02	1.18	1.36
45 deg bend	1	-	6	-	-	0.24	0.00	0.00	0.02	0.04	0.08	0.12	0.17	0.24	0.31	0.39	0.48	0.58	0.69	0.81	0.94
Piping Friction	-	-	6	5	100	-	0.00	0.01	0.04	0.08	0.13	0.20	0.28	0.38	0.48	0.60	0.73	0.87	1.02	1.18	1.36
Wye, thru	1	-	6	-	-	0.30	0.00	0.01	0.02	0.05	0.10	0.15	0.22	0.29	0.38	0.49	0.60	0.73	0.86	1.01	1.18
Piping Friction	-	-	6	6	100	-	0.00	0.01	0.04	0.06	0.13	0.20	0.28	0.38	0.48	0.60	0.73	0.87	1.02	1.18	1.36
45 deg bend	1	-	6	-	-	0.24	0.00	0.00	0.02	0.04	0.08	0.12	0.17	0.24	0.31	0.39	0.48	0.58	0.69	0.81	0.94
Piping Friction	-	-	6	6	100	-	0.00	0.01	0.04	0.08	0.13	0.20	0.28	0.38	0.48	0.60	0.73	0.87	1.03	1.18	1.36
Gate Valve	1	-	6	-	-	0.12	0.00	0.00	0.01	0.02	0.04	0.06	0.09	0.12	0.15	0.19	0.24	0.29	0.35	0.41	0.47
Pump																					
						Subtotal:	0.00	0.06	0.23	0.50	0.87	1.33	1.89	2.54	3.27	4.10	5.01	6.02	7.11	8.28	9.54

B. HEAD LOSS CALCULATION FOR 6-INCH DISCHARGE FORCE MAIN FROM PUMP TO CONNECTION WITH NEW 4300 FORCE MAIN

Fitting	No.	Inlet Dia.*	Outlet Dia,*	Length ft	C	K	(GPM) 0	100	200	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400
Check Valve	1	-	6	-	-	1.50	0.00	0.05	0.12	0.27	0.48	0.75	1.08	1.47	1.92	2.43	3.00	3.63	4.32	5.07	5.88
90 deg bend	1	-	6	-	-	0.45	0.00	0.01	0.04	0.08	0.14	0.22	0.32	0.44	0.58	0.73	0.90	1.09	1.30	1.52	1.76
Piping Friction (FRP)	-	-	6	6	140	-	0.00	0.01	0.02	0.04	0.07	0.11	0.15	0.20	0.26	0.32	0.39	0.47	0.55	0.64	0.73
Plug Valve (3-way)	1	-	6	-	-	0.45	0.00	0.01	0.04	0.08	0.14	0.22	0.32	0.44	0.58	0.73	0.90	1.09	1.30	1.52	1.76
Piping Friction (FRP)	-	-	6	6	140	-	0.00	0.01	0.02	0.04	0.07	0.11	0.15	0.20	0.26	0.32	0.39	0.47	0.55	0.64	0.73
45 deg bend	2	-	4	-	-	0.24	0.00	0.05	0.19	0.44	0.78	1.21	1.75	2.38	3.11	3.94	4.86	5.86	7.00	8.21	9.52
Piping Friction (FRP)	-	-	6	6	140	-	0.00	0.01	0.02	0.04	0.07	0.11	0.15	0.20	0.26	0.32	0.39	0.47	0.55	0.64	0.73
Increaser	1	6	10	2	-	0.175	0.00	0.00	0.01	0.03	0.05	0.08	0.11	0.15	0.19	0.25	0.30	0.37	0.44	0.51	0.60
Piping Friction (PVC) to connection	-	-	10	3696	140	-	0.00	0.28	1.02	2.16	3.68	5.55	7.78	10.35	13.25	16.48	20.02	23.88	28.06	32.54	37.32
Subtotal (to point of connection with 4300 Millersport PS force main):							**0.00**	**0.40**	**1.48**	**3.18**	**5.49**	**8.37**	**11.83**	**15.84**	**20.41**	**25.51**	**31.16**	**37.34**	**44.05**	**51.28**	**59.03**

C. HEAD LOSS CALCULATION FOR 6-INCH DISCHARGE FORCE MAIN FROM DOCKSIDE AND 200 GPM FLOW FROM 4300 MILLERSPORT (DESIGN FLOW OF 4300 MILLERSPORT PS PUMPS)

Fitting	No.	Inlet Dia.*	Outlet Dia,*	Length ft	C	K	(GPM) 200	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500	1,600
Piping Friction (PVC) to discharge	-	-	10	5139	140	-	1.42	3.00	5.11	7.72	10.82	14.39	18.43	22.93	27.84	33.21	39.01	45.24	51.89	58.95	66.43
Pipe Exit	1	-	10	-	-	1.00	0.01	0.02	0.04	0.06	0.09	0.13	0.17	0.21	0.26	0.31	0.37	0.44	0.51	0.58	0.66
Subtotal (for total force main length):							**1.43**	**3.03**	**5.15**	**7.79**	**10.92**	**14.52**	**18.59**	**23.12**	**28.10**	**33.53**	**39.39**	**45.68**	**52.39**	**59.53**	**67.09**

SUMMARY TABLE

FLOW (GPM)		0	100	200	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400
PUMP STATION																
WET WELL LOW WATER LEVEL (from drawing)		556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60
WET WELL HIGH WATER LEVEL (from drawing)		559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10	559.10
FORCE MAIN																
VELOCITY IN FORCE MAIN (fps)	DIAMETER (inch): 6	0.00	1.14	2.27	3.41	4.55	5.68	6.82	7.95	9.09	10.23	11.36	12.50	13.64	14.77	15.91
(recommended to operate between 2 and 8 fps per 10SS)	10	0.00	0.41	0.82	1.23	1.64	2.05	2.45	2.86	3.27	3.68	4.09	4.50	4.91	5.32	5.73
HEAD LOSSES IN FORCE MAIN (sum of suction losses and discharge losses)		1.43	3.49	6.86	11.47	17.27	24.22	32.31	41.50	51.78	63.14	75.56	89.03	103.55	119.10	135.67
HEAD LOSSES IN FORCE MAIN (to point of connection)		0.00	0.46	1.71	3.69	6.36	9.70	13.71	18.37	23.68	29.61	36.17	43.36	51.15	59.56	68.58
Discharge Pressure (assumes free discharge)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PUMP DISCHARGE PIPE EXIT ELEVATION***		574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80	574.80
MIN SYSTEM CURVE		17.1	19.2	22.6	27.2	33.0	39.9	48.0	57.2	67.5	78.8	91.3	104.7	119.2	134.8	151.4
MAX SYSTEM CURVE		19.6	21.7	25.1	29.7	35.5	42.4	50.5	59.7	70.0	81.3	93.8	107.2	121.7	137.3	153.9

Now to determine pressure at point of interconnection, assume pipe elevation at point of interconnection is the same as ultimate discharge
Use existing pump curve and subtract headloss from Dockside PS to connection point.

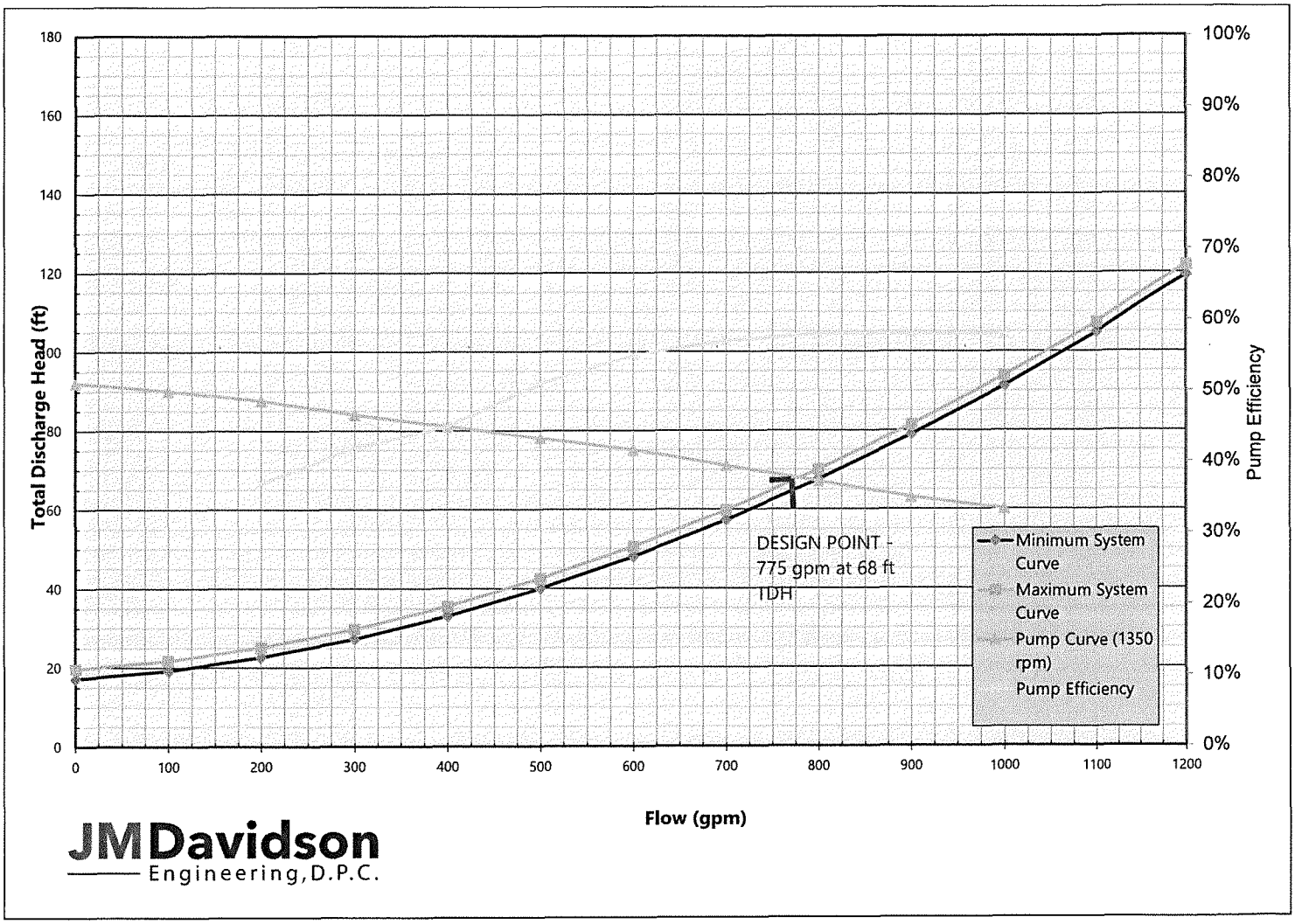
Pump curve	92.0	90.0	87.5	84.0	81.0	78.0	75.0	71.0	67.0	63.0	60.0
Pump curve minus headloss	92.0	89.5	85.8	80.3	74.6	68.3	61.3	52.6	43.3	33.4	23.8

At flow of approximately 800 gpm, pressure is approximately 53 ft. That pressure was added into the calculations for 4300 Millersport.

Calculations Completed 3/16/2023 *by* A. Hintz
Calculations Checked 3/21/2023 *by* C. Goerss-Murphy

Conclusion: Adding the flow from 4300 Millersport will decrease the Dockside Pump Station capacity from 833 gpm to approximately 775 gpm

Dockside + 4300 Curve (max)



JMDavidson
Engineering, D.P.C.

Dockside + 4300 Graph

Attachment 3

4300 Millersport Pump Station Calculations and Curves

SYSTEM HEAD CURVE DETERMINATION

TOWN OF AMHERST/ WM. SCHUTT ASSOCIATES
4300 MILLERSPORT HIGHWAY
JMD Project No. 342301 - calculations of new 4300 Millersport Pump Station (designed by Wm Schutt Associates)

JMDavidson Engineering, D.P.C.

The following formulas and assumptions were used in the calculations contained in this spreadsheet:

1. Pump operation scenarios: From Pump Suction Well to Discharge at Dockside Pump Station Force Main, assumes one pump in operation, 2nd pump as standby only (per Ten States' Standards)

2. Information on pumps, force main alignment and proposed flows provided by Wm Schutt on 3/9/2023.

3. Piping head loss calculations use Hazen-Williams Formula for Water
   h=[(4.73*Q^1.85)*L]/(C^1.85*D^4.87) where: h = Head Loss
   Q = Flow (cfs)
   C = Roughness Coefficient
   D = Pipe Diameter (ft.)
   L = Pipe Length (ft.)

4. Fitting, entrance, and exit head loss calculations for water:
   $h=KV^2/2g$ where: h = Head Loss
   K = Resistance Coefficient
   V = Flow Velocity (Q/A)
   g = Gravity (32.2 ft/sec^2)

K-values were obtained from "Cameron Hydraulic Data Handbook, 18th Edition" (1998) by Ingersoll-Dresser Pumps
For reducers, velocity of smaller end is used and for increasers the difference between the small and large end square velocities is used .
For tees with different inlet and outlet diameters, velocity in smaller diameter pipe is used.

A. HEAD LOSS FROM SUCTION TO EACH PUMP (WET PIT SUBMERSIBLE)

Pump design point is 200 gpm at 75' TDH (from info provided by Wm Schutt)

Fitting	No.	Inlet Dia.	Outlet Dia,	Length ft	C	K	(GPM) 0	20	40	60	80	100	120	140	160	180	200	220	240	260	280
Entrance Loss	1	-	4	-	-	0.50	0.00	0.00	0.01	0.02	0.03	0.05	0.07	0.10	0.13	0.16	0.20	0.24	0.29	0.34	0.40
Pump																					
						Subtotal:	0.00	0.00	0.01	0.02	0.03	0.05	0.07	0.10	0.13	0.16	0.20	0.24	0.29	0.34	0.40

B. HEAD LOSS CALCULATION FOR 4-INCH DISCHARGE FORCE MAIN FROM PUMP TO DOCKSIDE FORCE MAIN

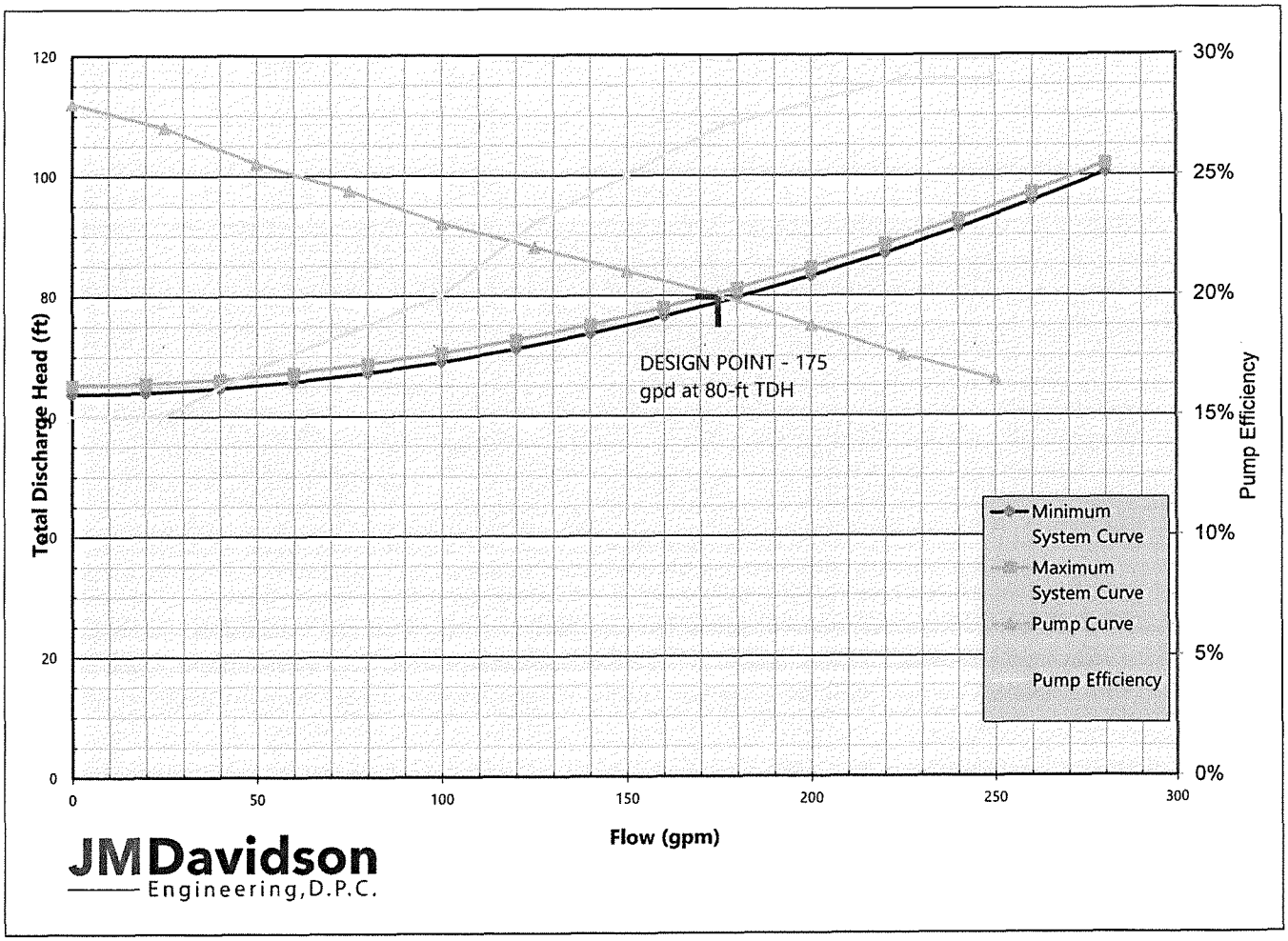
Fitting	No.	Inlet Dia.*	Outlet Dia,*	Length ft	C	K	(GPM) 0	20	40	60	80	100	120	140	160	180	200	220	240	260	280
90 deg bend	1	-	4	-	-	0.51	0.00	0.00	0.01	0.02	0.05	0.05	0.07	0.10	0.13	0.17	0.21	0.25	0.30	0.35	0.40
Piping Friction	-	-	4	6	100	-	0.00	0.00	0.01	0.03	0.05	0.07	0.10	0.14	0.18	0.22	0.27	0.32	0.37	0.43	0.50
90 deg bend	1	-	4	-	-	0.51	0.00	0.00	0.01	0.02	0.03	0.05	0.07	0.10	0.13	0.17	0.21	0.25	0.30	0.35	0.40
Piping Friction	-	-	4	6	100	-	0.00	0.00	0.01	0.03	0.05	0.07	0.10	0.14	0.18	0.22	0.27	0.32	0.37	0.43	0.50
Gate Valve	1	-	4	-	-	0.14	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.10	0.11
Check Valve	1	-	4	-	-	1.70	0.00	0.01	0.03	0.06	0.11	0.17	0.25	0.34	0.44	0.56	0.69	0.83	0.99	1.16	1.35

Plug Valve	1	-	4	-	-	0.31	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.10	0.13	0.15	0.18	0.21	0.25
90 deg bend	1	-	4	-	-	0.51	0.00	0.00	0.01	0.02	0.03	0.05	0.07	0.10	0.13	0.17	0.21	0.25	0.30	0.35	0.40
Cross, Branch Flow	1	-	4	-	-	1.02	0.00	0.00	0.02	0.04	0.07	0.10	0.15	0.20	0.26	0.33	0.41	0.50	0.59	0.70	0.81
Gate Valve	1	-	4	-	-	0.14	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.10	0.11
Piping Friction	-	-	4	600	140	-	0.00	0.20	0.73	1.55	2.63	3.98	5.58	7.42	9.50	11.81	14.35	17.12	20.11	23.32	26.74
45 deg bend	2	-	4	-	-	0.27	0.00	0.00	0.01	0.02	0.03	0.05	0.08	0.11	0.14	0.18	0.22	0.26	0.31	0.37	0.42
46 deg bend	2	-	4	-	-	0.27	0.00	0.00	0.01	0.02	0.03	0.05	0.08	0.11	0.14	0.18	0.22	0.26	0.31	0.37	0.42
45 deg bend	4	-	4	-	-	0.27	0.00	0.00	0.02	0.04	0.07	0.11	0.16	0.21	0.28	0.35	0.44	0.53	0.63	0.74	0.86
Gate Valve	1	-	4	-	-	0.14	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.10	0.11
45 deg bend	6	-	4	-	-	0.27	0.00	0.01	0.03	0.06	0.10	0.16	0.24	0.32	0.42	0.53	0.66	0.79	0.94	1.11	1.29
Wye (10" x 10" x 4")	1	-	4	-	-	1.02	0.00	0.00	0.02	0.04	0.07	0.10	0.15	0.20	0.26	0.33	0.41	0.50	0.59	0.70	0.81
Pipe Exit	1	-	4	-	-	1.00	0.00	0.00	0.02	0.04	0.06	0.10	0.15	0.20	0.26	0.33	0.40	0.49	0.58	0.68	0.79
						Subtotal:	**0.00**	**0.25**	**0.93**	**2.00**	**3.43**	**5.22**	**7.36**	**9.83**	**12.64**	**15.78**	**19.25**	**23.04**	**27.14**	**31.56**	**36.29**

SUMMARY TABLE

FLOW (GPM)	**0**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**
PUMP STATION															
WET WELL LOW WATER LEVEL (from drawing)	557.79	557.79	557.79	557.79	557.79	557.79	557.79	557.79	557.79	557.79	557.79	557.79	557.79	557.79	557.79
WET WELL HIGH WATER LEVEL (from drawing)	559.29	559.29	559.29	559.29	559.29	559.29	559.29	559.29	559.29	559.29	559.29	559.29	559.29	559.29	559.29
FORCE MAIN															
VELOCITY IN FORCE MAIN (fps) DIAMETER (inch): 4	0.00	0.51	1.02	1.53	2.05	2.56	3.07	3.58	4.09	4.60	5.11	5.62	6.14	6.65	7.16
(recommended to operate between 2 and 10 fps per 10SS)															
HEAD LOSSES IN FORCE MAIN (sum of suction losses and discharge losses)	0.00	0.26	0.94	2.02	3.46	5.27	7.43	9.93	12.77	15.95	19.45	23.28	27.43	31.90	36.69
Discharge Pressure (see Dockside PS Calcs)	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00
PUMP DISCHARGE PIPE EXIT ELEVATION***	570.00	570.00	570.00	570.00	570.00	570.00	570.00	570.00	570.00	570.00	570.00	570.00	570.00	570.00	570.00
MIN SYSTEM CURVE	63.7	64.0	64.7	65.7	67.2	69.0	71.1	73.6	76.5	79.7	83.2	87.0	91.1	95.6	100.4
MAX SYSTEM CURVE	65.2	65.5	66.2	67.2	68.7	70.5	72.6	75.1	78.0	81.2	84.7	88.5	92.6	97.1	101.9

Calculations Completed 3/15/2023 *by* A. Hintz
Calculations Checked 3/21/2023 *by* C. Goerss-Murphy


120
100
80
60
40
20
0
Total Discharge Head (ft)
30%
25%
20%
15%
10%
5%
0%
Pump Efficiency
0
50
100
150
200
250
300
Flow (gpm)
DESIGN POINT - 175
gpd at 80-ft TDH
Minimum System Curve
Maximum System Curve
Pump Curve
Pump Efficiency
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4300 Graph